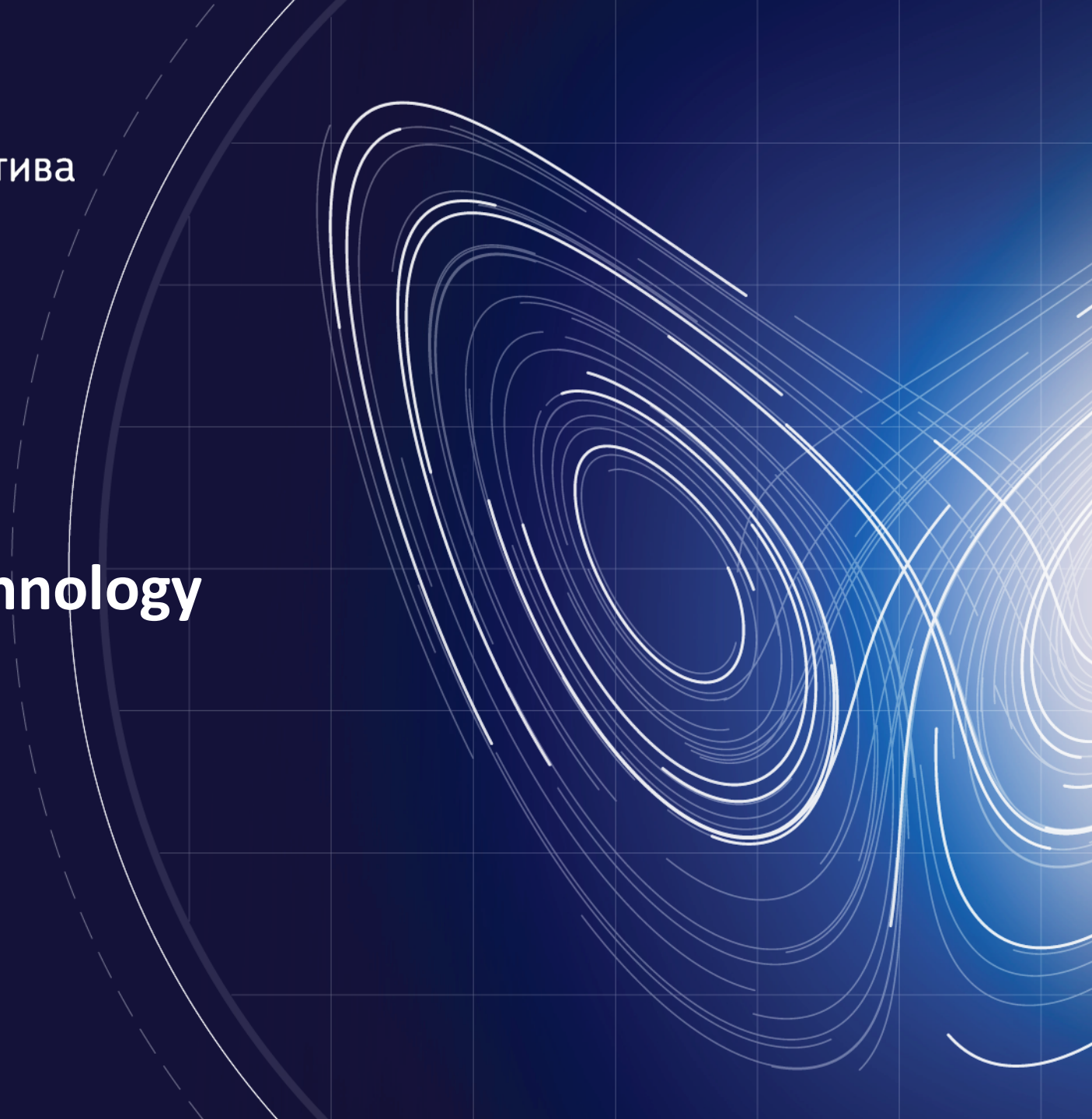


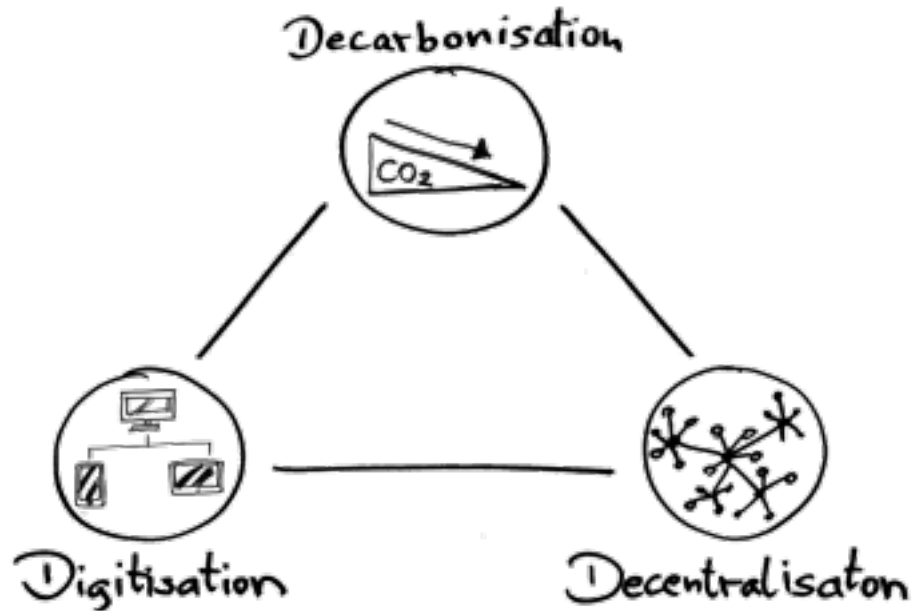
Национальная
технологическая инициатива

Пространство возможного

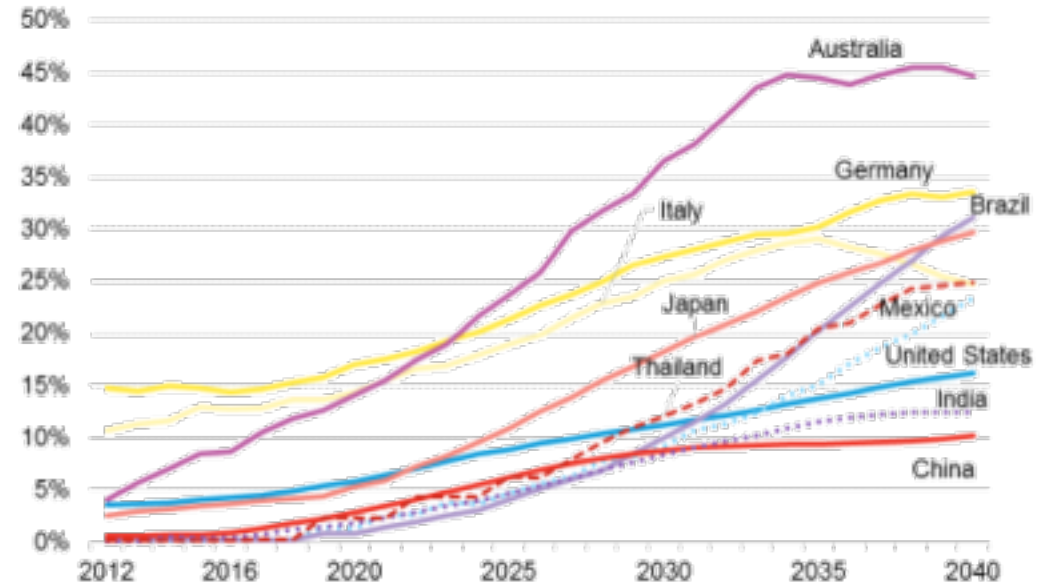
EnergyNet

The National Technology Initiative





Percentage of decentralized energetic in countries energy mixes forecast



Causes

Growth in demand

Growth of customer requirements

Climate change

New investment cycle

New urbanization

Drivers

Distributed energy (RES, ESS)

Active customers

Digitalization of infrastructure

Intelligence management

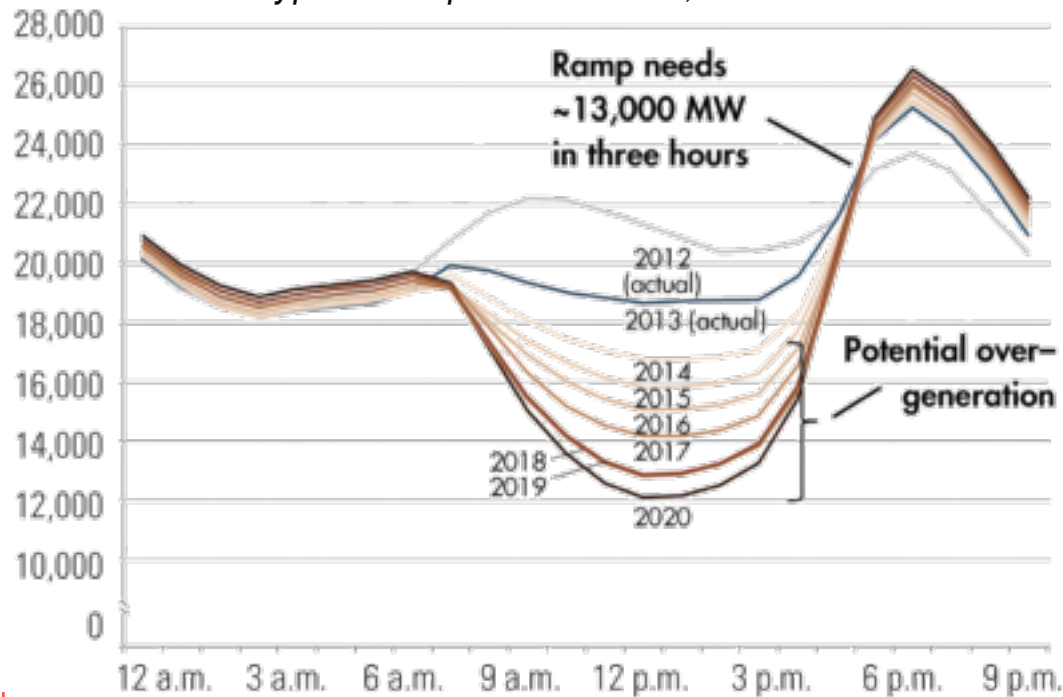
Digital financial technologies

RES in energy mix provides new problems

Decarbonization and increase of RES rate in energy mix alone decrease load factor, make energy systems much more complicated to operate for dispatching control, call capacity margin growth

These forces and problems **reduce power systems efficiency, increase capacity costs and lead to cost of electricity escalations for end consumers**

California typical load profile in March, fact and forecast



Source: CAISO

It calls new technology and system architectural decisions for new energetics efficiency growth

- Peer-to-peer sharing of electricity by RES
- **Decrease day net demand**

Share of distributed generation



- ESS in households and buildings
- **Cut peaks and level up gaps of net demand**

Distributed energy storage



- Technologies for equipment
- **Decrease whole demand**

Energy Efficiency



- Services for consumption decrease during the system peak
- **Decrease peak net demand**

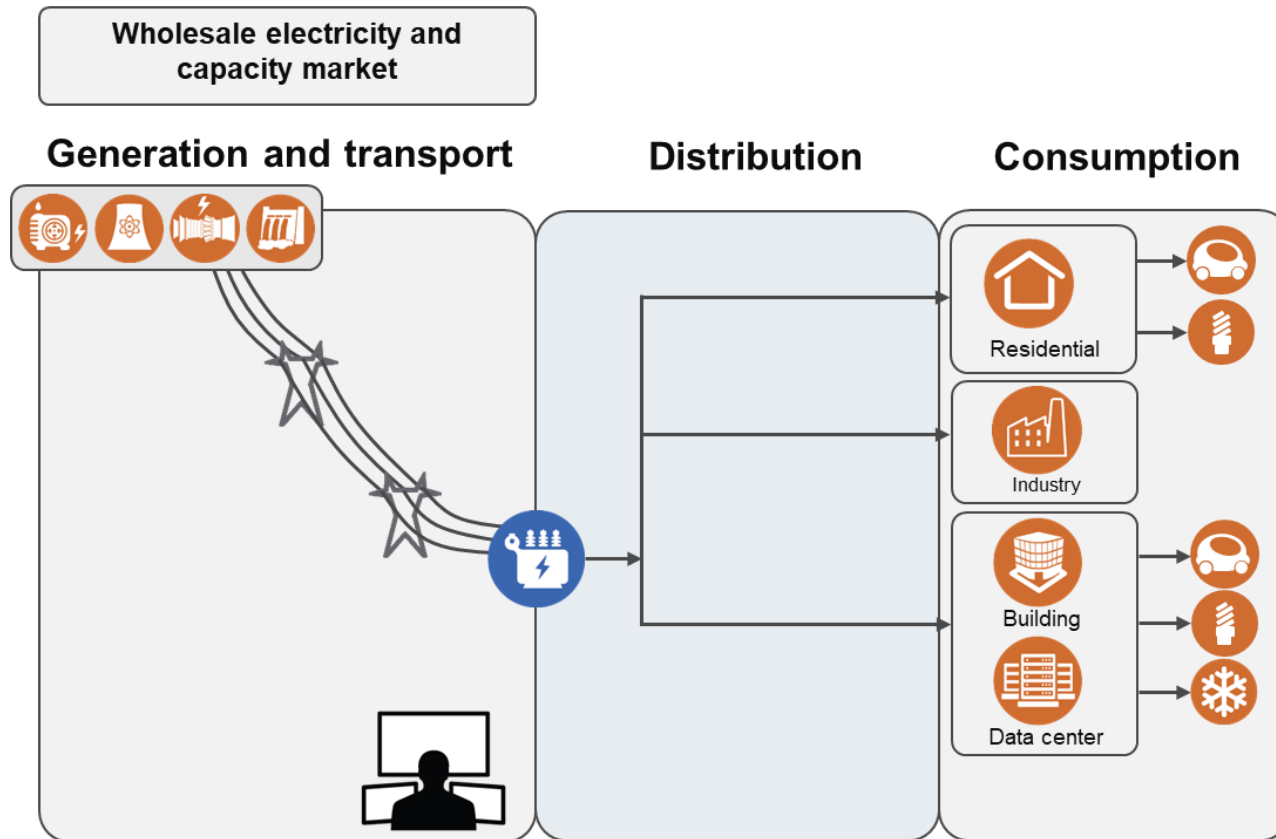
Demand Response



Present (centralized) power systems architecture

Today's power systems with hierarchic architecture, centralized dispatching control, one-directional power flows, wholesale market and consumer's requirements unification lose its efficiency and attraction

We want it to have new internals, properties and abilities



Proactive answers to consumer's requirements diversity

DER, prosumers, active (flexible) consumers integration

Power sharing, flexible aggregation and coordinate capacity management

Decentralized markets for peer-to-peer energy exchange and other services



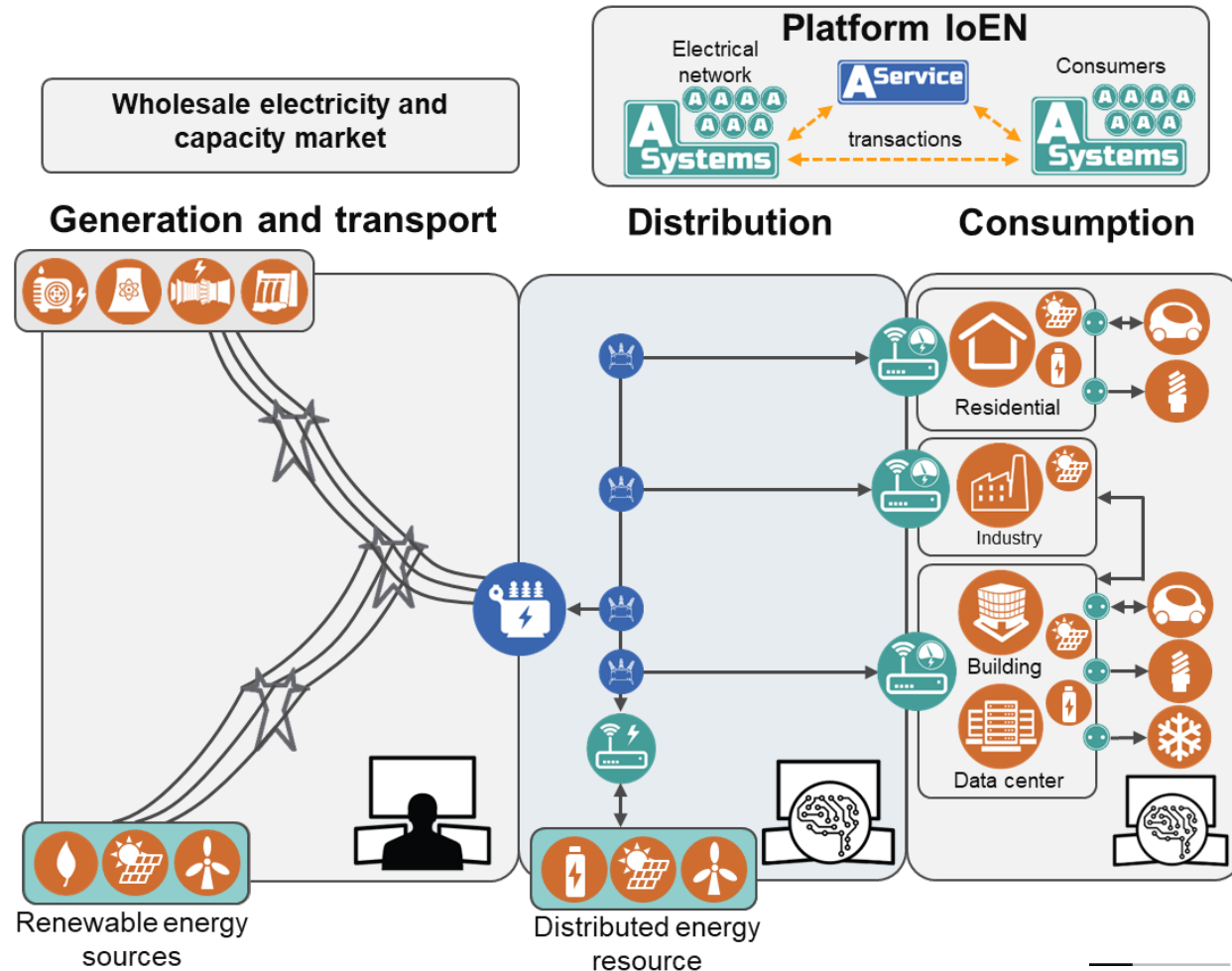
New power systems architecture

INTERNET OF ENERGY – ecosystem of producers and consumers of electric energy, who are integrated and interconnected in common infrastructure for power & energy sharing without any limits



Transition to new power systems architecture provides by new technologies:

1. Solid-state power electronics
2. Energy storage systems
3. Distributed multi-agency intelligence control
4. Digital platforms, big data & IoT
5. Blockchain, smart-contracts and decentralized autonomous organizations (DAO)

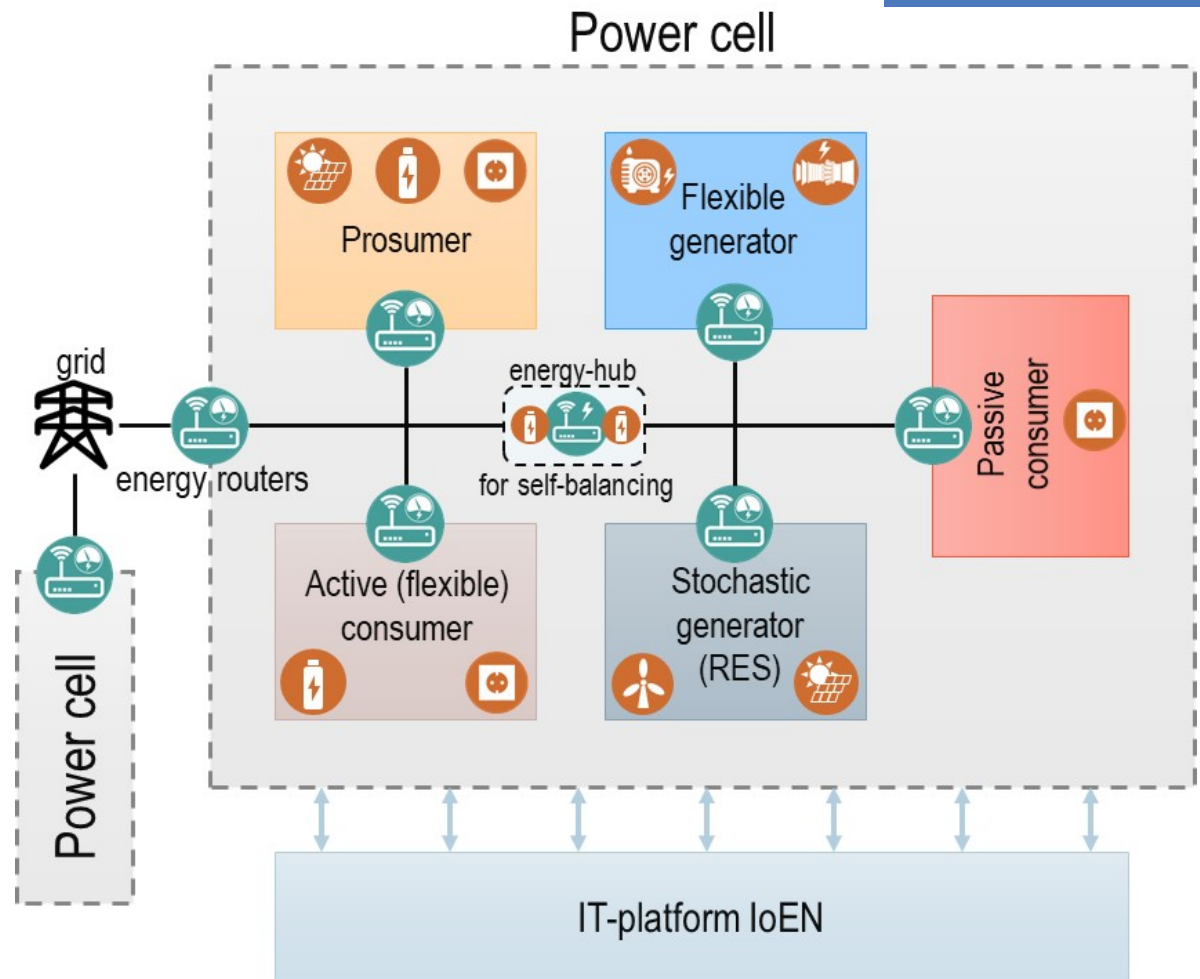


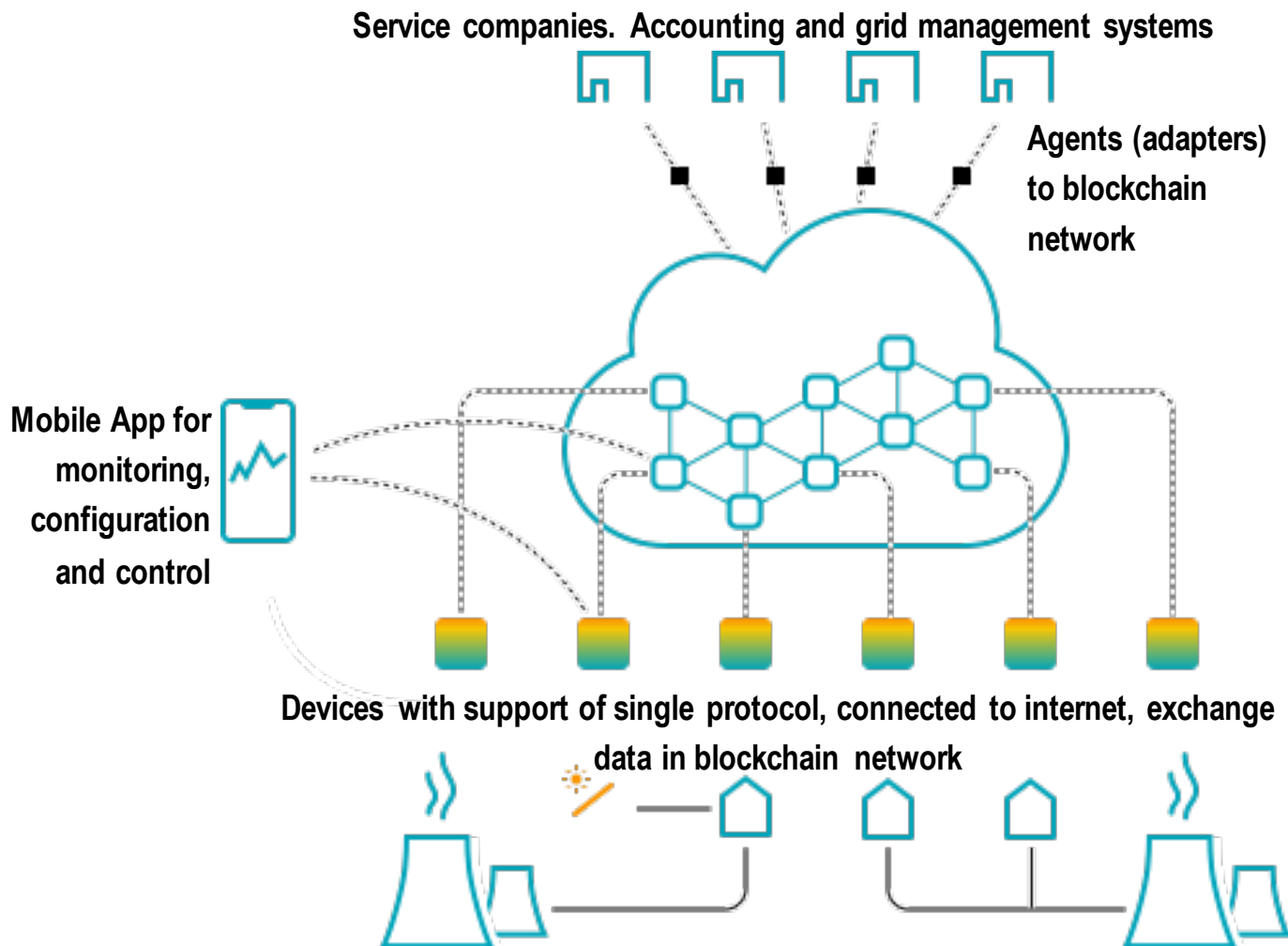
Power cell – Internet of Energy basic unit



Internet of Energy is electric & informational grid of **power cells** –interconnected by special interfaces (energy routers) units with partial self-balancing. Power cells carry on energy transactions to bring into action IoEN services via IT-platform.

ARTIFICIAL INTELLIGENCE allows to use Plug&Play mode devices, create self-learning self-organizing MICROGRIDS of any configurations, actively introducing the consumer by services and technologies of distributed registries





Functions:

- provides interoperability, pulling accounting functionality and energy calculations from the application layer to the protocol layer
- serves as a set of building blocks, which during construction can be assembled into more complex and useful applications for energy
- flexible approach to building an application architecture will allow local regulatory requirements
- supports billions of devices, trillions of transactions with state channels
- blockchain as technology to solve issues of trust, no central server solution

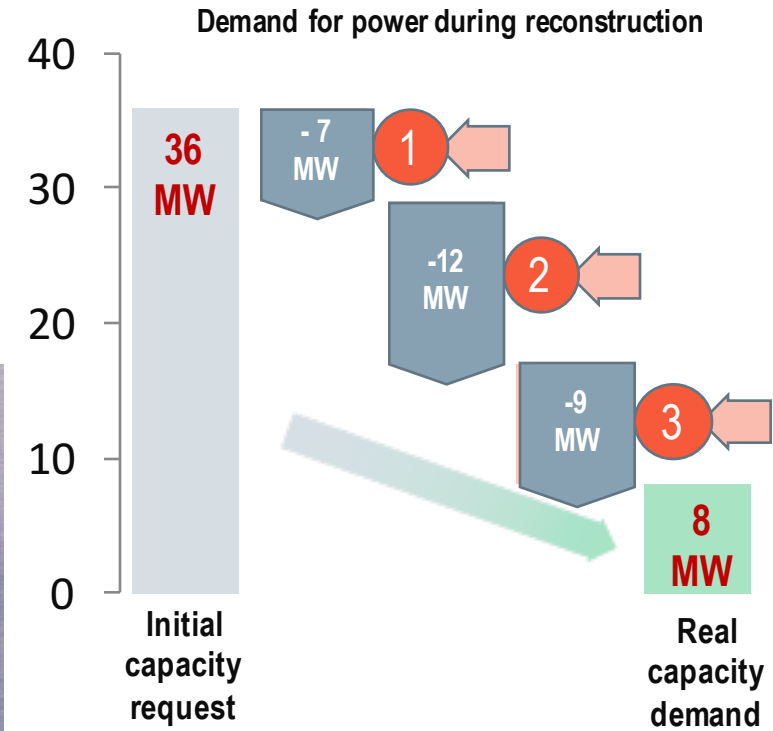
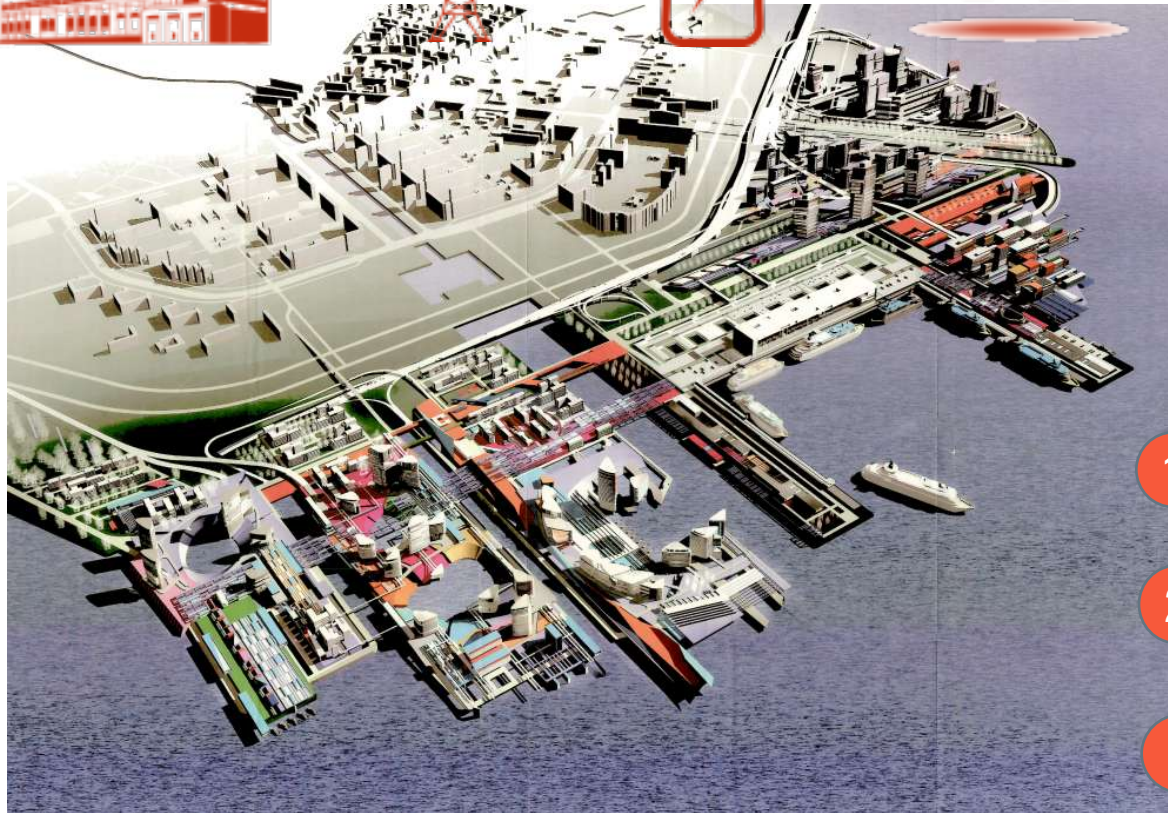
Seaport case study

Generation:
2 TPS – 18 MW
DG – 2 MW
Load – **17%**

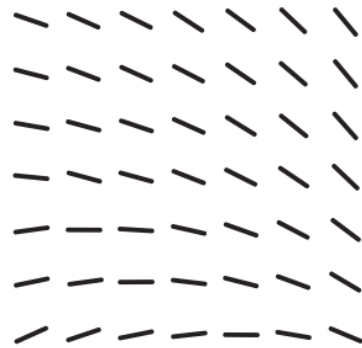
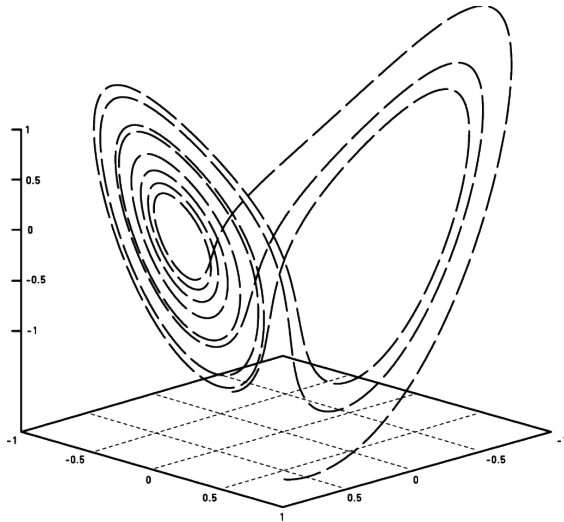
Nets:
S – 30 pieces
PL – 150 km
Load – **18%**

ESS:
Traction batteries
and UPS – 1 MWh

Consumers:
Load – 26 MW



- 1 Forecast of demand for capacity based on a single analytical model and measurements
- 2 Intelligent load management system
- 3 Effective use of own generation

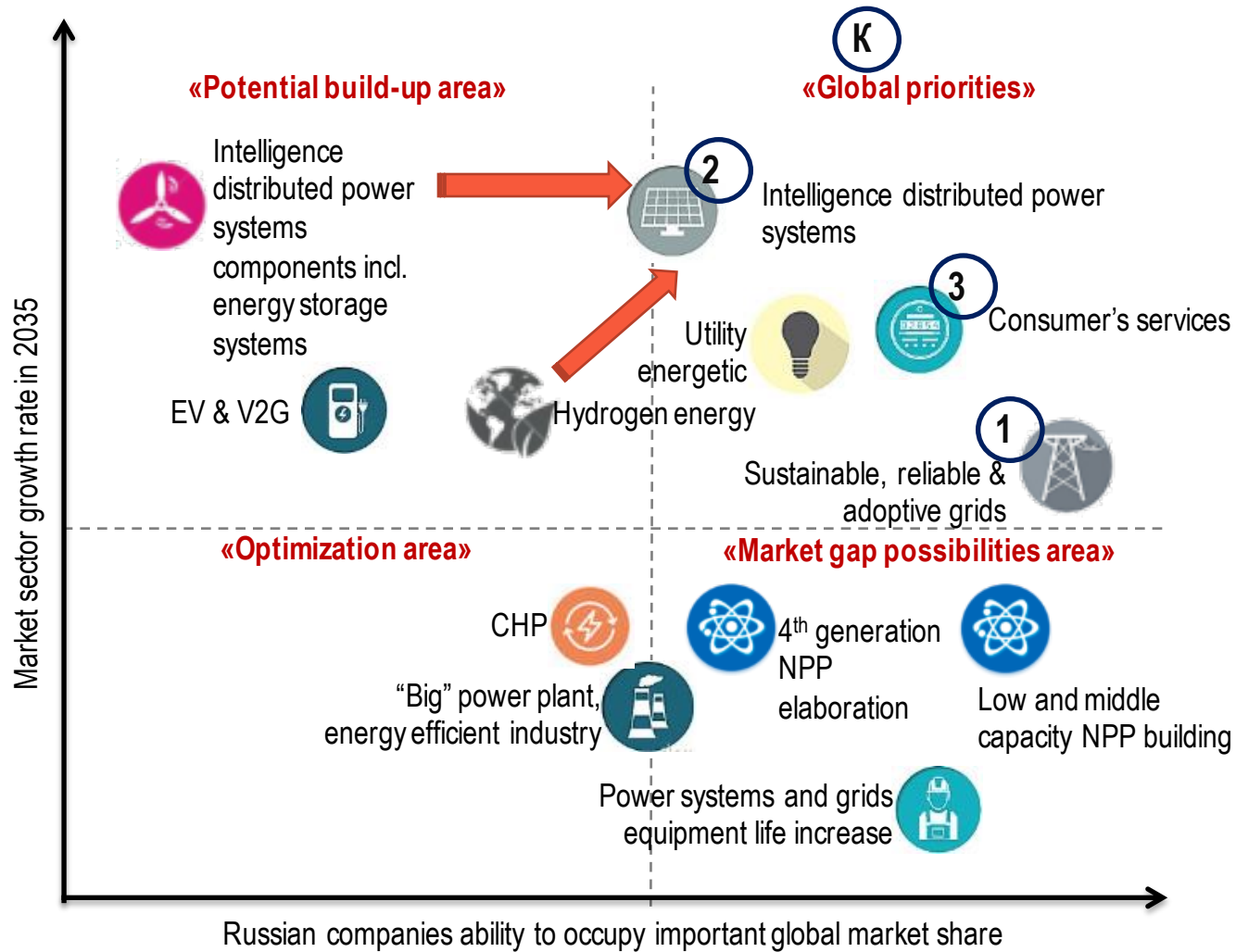


Energynet

National
Technology Initiative

National Technology Initiative (NTI) has started by the President V.V. Putin's Address to the Federal Asseble of Russia in 2014 to create next generation technology decisions for keys industries and fast growing global markets and has targeted on hi-tech export development

«**ENERGYNET**» roadmap is one of the NTI branch to elaborate new power and grid technologies and complex platforms as **Internet of Energy** is. It has approved by General Committee of President Council for Economy Modernization and Innovative Development of Russia in 2016



(K) - Complex projects

Energynet companies community

1. Complex solutions for cities and industry
2. New power, information and social technologies
3. Open collaboration model

① Sustainable, reliable & adoptable grids



② Smart distributed energy systems



③ Consumer services

